Chem 351 – Fall 2020
Physical Chemistry I: Chemical Thermodynamics

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Office Hours: Contact me. Special pre-exam times

Class information and copies of all course handouts and problem assignments will be posted on laulima.

Textbook: McQuarrie and Simon, ISBN:978-0-935702-99-6. This book will also be used for Chem 352 next semester.

Prerequisites: Chem 162 or 171 and Chem 274; Physics, 272; Math 243, or equivalent.

Exams: Three mid-term exams (20 pts each) and an optional Final (40 pts) = 100 or 60 pts. The Final Exam can only help your grade.

Course Grade: will be based upon a Gaussian distribution (bell curve) of the class grades.

Learning Objectives

Develop an understanding of how the laws of thermodynamics can be applied to various physical processes and reactions in chemistry.

Develop a feel for the chemical information provided by various state functions such as internal energy U, enthalpy H, entropy S, Gibbs free energy G and the chemical potential μ.

Learn how to apply thermodynamics to recognize when a system is in equilibrium or when the state of system will spontaneously undergo a change to a different state.

Develop quantitative problem solving skills in the application of thermodynamics to different chemical systems.

Course Outline

1. Gases, Equations of State and Kinetic Molecular Theory: Ideal and real gases, theoretical models, compressibility factor, critical phenomena, molecular collisions, effusion. (Chapter 16:all, Ch. 27 parts)

2. First Law of Thermodynamics and Thermochemistry: System, surroundings, heat, work, internal energy, properties of state functions. (Chapter 19:1-6)

3. Enthalpy, heat capacity, enthalpies of reaction, calorimetry, bond energies. (Chapter 19: 6-12)

EXAM I

4. Second and Third Laws of Thermodynamics, entropy and probability for change, statistical mechanical interpretation for simple systems, heat engines, the Carnot cycle, reversibility, thermodynamic efficiency, calculation of entropy changes for chemical reactions and physical transformations. (Chapter 20 and Chapter 21):

5. Helmholtz and Gibbs free energy and their relationship to other thermodynamic state functions and variables, fugacity and activity. Chemical equilibrium and equilibrium constants and their application to chemical systems, Le Chatelier's Principle, homogeneous and heterogeneous chemical reactions, chemical potential, pressure and temperature dependence of equilibrium constants. (Chapter 22 and Chapter 26)

EXAM II

5. Single-component phase equilibria and ideal Solutions, phase diagrams (P-T space), Clausius-Clapeyron equation and applications, Raoult's and Henry's Laws, partial molar quantities, Gibbs-Duhem equation, activity coefficients, colligative properties. (Chapter 23)

6. Multi-component phase equilibria and the phase rule, phase diagrams (P-X and T-X space) for binary nonelectrolytic liquid mixtures, distillation, azeotropes, solid-liquid binary phase diagrams, solid solutions. (Chapter 24 and Chapter 25)

EXAM III

FINAL EXAM